

## Review Article

# Current models of "quality" - an introduction for anaesthetists

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*The purpose of this review is to provide the practicing anaesthetist with an historical perspective of quality, a summary of current models, and an introduction to the expectations of accreditors. Articles were obtained from an electronic literature search on Silver Platter® using the search terms Quality, Quality assurance, Anes\*, and Anaes\*. In addition, textbooks on quality assurance in health care, quality improvement texts from business management, and accreditation documents were reviewed. Quality systems in health care are derived from business or industrial models. Study of this field is hampered by poorly defined terminology and jargon. Over the years, many different models have been used in health care, but recent studies have investigated the effectiveness of methods such as Quality Improvement. Many of the systems used by hospitals appear to have been prompted by requirements of accreditation standards. Recently, systems of hospital organization have appeared which link Quality Assurance, Quality Improvement, risk management and utilization management. Despite the confusion created by ill-defined terminology and rapid change in some definitions, anaesthetists need to be aware of the basic models of accreditation requirements.*

*L'objet de cette revue consiste à fournir à l'anesthésiste une perspective historique de la gestion de la qualité, un résumé des modèles courants et un aperçu des exigences des accréditeurs. Les documents ont été obtenus à partir d'une recherche électronique sur Silver Platter® en utilisant les termes Quality, Quality assurance, Anes\* et Anaes\*. De plus des manuels traitant de la gestion de la qualité dans les services de santé, des textes sur l'amélioration de la qualité dans l'administration des*

*affaires et les documents d'accréditation ont été consultés. Les systèmes de gestion de la qualité sont dérivés de modèles financiers et industriels. Les études dans ce domaine sont entravées par une terminologie et un jargon mal définis. Depuis plusieurs années, en soins de santé, on utilise plusieurs modèles, mais des études récentes ont examiné l'efficacité de méthodes telles que l'amélioration de la qualité. Plusieurs des systèmes hospitaliers sont déterminés par les standards d'accréditation. Des systèmes d'organisation hospitalière d'origine récente relient ensemble la gestion de la qualité, l'amélioration de la qualité, et la gestion du risque. Malgré la confusion causée par une terminologie mal définie et les variations rapides de définition, les anesthésistes doivent connaître les modèles de base et les exigences des accréditeurs.*

Over the past 20 yr, a number of methods, originally developed in industry, have been applied to health care in an attempt to improve quality. Starting with Quality Assurance (QA), these concepts have been adapted to medical practice and health care institutions. Many of these techniques have been described in the lay press and most anaesthetists are aware of the range of acronyms which describe the many various approaches to quality.\* Some of these include Quality Control (QC), Quality Assurance (QA), Total Quality Management (TQM), and Continuous Improvement (CI); however, many anaesthetists would have difficulty in identifying the unique attributes of each approach, or if there are any meaningful differences among them. In recent years, QA activities have been incorporated into hospitals, QA being an important part of the accreditation process. For example, certain aspects of QA have been used in most anaesthetic departments, including morbidity and mortality review and critical incident investigation. However, individual anaesthetists may not be familiar with all of these approaches, nor with the potential breadth and strength of

### Key words

ANAESTHESIA: quality assurance.

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\*For example: The cracks in quality. The Economist. April 18, 1992, p. 67; and Fife S. The total quality muddle. Report on Business Magazine. November, 1992, pp. 64-73.

QA. This review will provide anaesthetists with an introduction to the models used in the pursuit of quality in hospitals, including definitions and historical aspects of quality. Details of QA and QI will be given, together with examples of application to a clinical anaesthetic department. Finally, an integrated system for quality will be described, showing how the newer methods of quality improvement, risk management and utilization review can be linked with quality assurance, in a manner that will also satisfy external constraints, i.e., the accreditation process.

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#### GLOSSARY

**Benchmarking** is the process of evaluating performance against specific criteria, including the performance of competitors or industry leaders.

**Quality Assurance (QA)** refers to activities which monitor the quality of a service and may include methods to improve the service. Quality assurance has three components: Structure, Process, and Outcome. Structure includes the physical plant, human resources and organization concerned with the activity of interest. Process includes the acts of delivering of care. Outcome includes the effects of the care.

**Quality Control** is the application of statistical techniques to a process in an effort to identify and minimize both random and non-random sources of variation.

**Quality Improvement (QI)** is "the effort to improve the level of performance of a key process. It involves measuring the level of current performance, finding ways to improve that performance and implementing new and better methods."<sup>30</sup>

**Quality Improvement tools:** The *Pareto diagram* is a histogram with the bars sequenced from most important to least important factors. It is a method to help determine the sequence in order to look for solutions.

**Quality Improvement tools:** The *Delphi survey* is a questionnaire method where individuals are asked to volunteer the most important perceived causes of a problem.

**Quality Improvement tools:** The *Cause and Effect (Ishikawa) diagram* is a fishbone diagram where the major causes of a problem (frequently categorized as Manpower, Machines, Methods, and Materials) are linked diagrammatically to the problem.

**Quality Improvement tools:** The *Control Chart* is a visual presentation of a performance measure over time in the form of a line graph and is used to indicate trends.

**Risk management (RM)** is a process of identifying and minimizing risk to patients, staff, and facilities.

**Utilization management (UM)** is a process of information gathering, strategic planning, and resource allocation to ensure most cost-effective utilization of resources.

#### Definition of quality

The Concise Oxford Dictionary defines "quality" as "possessing a high degree of excellence."<sup>1</sup> Donabedian defines quality medical care as "that kind of care which is expected to maximize an inclusive measure of patient welfare, after one has taken account of the balance of expected gains and losses that attend the process of care in all its parts."<sup>2</sup> Although excellence is an estimable goal, this definition is limiting. Just as beauty is in the eye of the beholder, so quality may be defined, and differently, be each individual observer. With respect to anaesthetic practice, the observers include the health care system, anaesthetists, surgeons and patients. Each of these observers shares points of commonality in the definitions of quality applied to anaesthesia. For example, all would expect quality to be associated with a low incidence of mortality and major morbidity. Societal factors, such as protection from natural disasters, a high standard of living, long life expectancy, and growing consumerism in health care, have contributed to a low tolerance for complications after anaesthesia. This is particularly so in a country such as Canada which in 1992 was acclaimed by the United Nations as the "best" country in which to live.

The health care system, represented by government or private payers, requires that excellence or quality is achieved within budget. Items subject to financial constraints include not only the facility and its equipment, but also manpower. In addition, health care systems expect the recognized wide variation in practice patterns to be controlled.<sup>3</sup> In hospitals, quality has been described as being defined by seven attributes requiring assessment by all departments, including anaesthesia. These attributes are: safety, provider competence, acceptability, accessibility, efficiency, appropriateness, and effectiveness.<sup>4</sup> Application of this model to an anaesthetic department is shown in Table I. Without such a comprehensive model, anaesthetists have defined quality according to easily identifiable measurement tools, e.g., morbidity and mortality statistics, or the peer review system of the American Society of Anesthesiologists.

For the surgeon, measure of quality in anaesthesia is often reflected in the factors which contribute to the facilitation of procedures. These include: careful, timely preoperative assessment; a well-anaesthetized patient in whom the degree of analgesia, muscle relaxation, immobility and lack of physiological derangement are appropriate for the operation; a positive course without consequence; and lack of patient complaint (e.g., sore throat) on follow-up visit. For the patient, quality is reflected in lack of dissatisfaction (unsure of what to praise, but definite as to what to complain about). Berwick and colleagues have stated that patients have "sensible, under-

TABLE 1 Seven attributes defining quality of care, as applied to an anaesthetic department (after Macintosh<sup>4</sup>)

| Attributes        | Basic question   | Typical activity   |
|-------------------|--|--|
| 1 Safety          | Are anaesthetics provided with minimal risk to patients?   | Risk management<br>Critical incident review<br>Morbidity and mortality review                            |
| 2 Competence      | Do you have the requisite knowledge, skills, and attitudes to provide the service?                               | Performance appraisal<br>Peer review process (e.g., Vitez)<br>Manpower planning                          |
| 3 Acceptability   | Does your department meet expectations of patients, surgeons, and accreditors?                                   | Customer evaluation:<br>Internal: surgeons<br>External: patients   |
| 4 Accessibility   | Is the department able to service its requirements? For example, availability of on-call staff                   | Measures of delay of surgery and cancellation rates<br>Availability for consultations and other services |
| 5 Efficiency      | Are anaesthetics provided in a timely and cost-effective manner?   | Utilization review<br>Budget information<br>Operating room utilization data                              |
| 6 Appropriateness | Does the Department provide the services it should? For example, an acute pain service, or in house OB coverage? | Case review<br>Benchmarking against other institutions   |
| 7 Effectiveness   | Are the right services being delivered in the proper fashion?  | Audits of patient outcome  |

standable, reasonable expectations of health care."<sup>5</sup> However, this may not always apply to anaesthesia, as public knowledge of this is quite limited.<sup>6,7</sup>

Who, therefore, is the important observer in the definition of quality? Even 20 yr ago this question would not have seemed necessary. Since then, gradual change has occurred in health care in the appreciation of whom the most significant observer should be. Predominance of the physician's view of quality has given way to appreciation of the patient, or customer's, point of view. "It is only recently that the total outcome of health care service has received attention relative to the value and quality to the patient."<sup>8</sup> In addition, the expectations of the other observers must be appreciated. Lack of a single definition of quality has created diversity in the perceived endpoint, with each observer focusing on a different one. This diversity of endpoints should not be seen as an ob-

struction but as a characteristic allowing and encouraging flexibility in the pursuit of quality. As the decade progresses, increasing fiscal problems will support the pursuit of quality by all, in part as a means to provide accountability to funding agencies,<sup>9-11</sup> but also to ensure the best care possible.

### Historical aspects of the study of quality

Quality in health care is not a new concept. Although many of the methods employed in the quest for quality have originated in other industries, the following quotation attributed to Florence Nightingale remains relevant: "The ultimate goal is to manage quality. But you cannot manage it until you have a way to measure it, and you cannot measure it until you are able to monitor it."<sup>8\*</sup>

### Preindustrial history

In about 2000 BC, the Hammurabai Code of Babylon "attempted not only to regulate the practice of medicine but also quoted a scale of fees and the relevant penalties for malpractice."<sup>12</sup> Half a century later in Ancient Egypt, doctors also followed these guidelines, as described in the Edwin Smith papyrus. The writings of Hippocrates showed an emphasis on the importance of observing the patient, or recording case details with accuracy, and of questioning the "efficacy of many treatments then in vogue."<sup>12</sup> Similar observations were made by Galen, who recognized the failure of certain treatments "in incurable cases."<sup>13</sup> In the middle ages, crafts and guilds contributed to the development and maintenance of standards. In 1342, the Lord Mayor of London appointed two Master Surgeons "to oversee the practice of their art and to report to him any colleagues who (were) defective."<sup>12</sup> In 1518, the charter of the Royal College of Physicians described the standards of medicine being upheld "both for their own honour and public benefit."<sup>14</sup> At this stage, however, there was little knowledge of systems which promote quality,<sup>15</sup> apart from the concept of apprentice/master.

### The industrial revolution

The need for a systematic approach to quality arose in the late 19th and early 20th centuries with the growth of industrial processes of increasing complexity. Industrial production required the cooperation of many individuals and the integration of numerous processes to manufacture a single product. The acceptability of each

\*Quoted in Kilshaw MF. Implementing an effective quality assurance program. In: Gelman D (Ed.). Medical Administration in Canadian Hospitals. Chapter F1. Canadian Medical Association, Ottawa, 1992.

individual's work was assured by inspection and adherence to predetermined standards. The importance of inspection in promoting quality in manufacturing processes was formalized in the early 20th century by F.W. Taylor and G.S. Radford. According to Taylor, "the inspector is responsible for the quality of the work."<sup>16</sup> The reliance on conformance to standards remains critical in health care today. The 1991 Canadian Council on Health Facilities Accreditation (CCHFA) accreditation document for Acute Care Hospitals is a 900 page workbook which catalogues the compliance of hospitals with predetermined standards.<sup>17</sup>

In the early 1930s, W.A. Shewhart, using experience gained while at Bell Laboratories, provided a scientific approach to quality control.<sup>18</sup> Shewhart recognized that random chance, and hence probability, played a large part in the variability seen in industrial processes. By developing a number of methods of sampling and analysis, Shewhart was able to differentiate random variation from non-random causes. These techniques, known as statistical quality control (SQC), were widely disseminated in World War II by the efforts of the United States government in seeking standardized products of high quality. Although SQC was not widely used in clinical departments, its potential was anticipated by early practitioners such as Florence Nightingale: "To understand God's thoughts we must study statistics, for these are the measure of his purpose."<sup>19</sup>

#### *Advent of quality assurance*

By the 1950's, quality control was recognized as a well-defined engineering and management discipline. Quality Assurance grew from the need for management to obtain similar control of processes beyond manufacturing. In the 1960's, the original model of QA in health care was defined by Donabedian. The triad of Structure, Process, and Outcome<sup>20</sup> was applied to diverse organizations and processes. In most areas of health care, gross measures of outcome, e.g., in-hospital mortality, were easily determined. Accreditors lacked proper tools to allow assessment of more refined measures, e.g., effect of care delivered on subsequent quality of life. In the absence of such outcome measures, regulatory agencies became more reliant on evaluation of elements of structure. Fear of regulatory agencies, external review, and litigation lead to resistance by health care workers to this limited model of QA, summarized by Berwick in his "Theory of Bad Apples."<sup>21</sup>

#### *Advent of quality improvement*

During the 1970's, increasing competition from Japanese industries caused many industries in the United States to investigate other models of improving quality. The ap-

preciation that "systems in complex organizations tend to remain stable in their level of performance."<sup>\*</sup> lead to new interest in quality improvement methods. By the late 1980's, some of these methods, e.g., "quality circles," had fallen into disuse, while others, especially the quality improvement methods developed by Deming,<sup>22</sup> Juran<sup>23</sup> and Crosby,<sup>24</sup> found an audience in health care in the United States and Canada. Activity of agencies, such as the Juran Institute in promotion of quality management techniques by workshops and video courses, lead to widespread adoption of these methods.

In the early 1990's, the emphasis placed on Process by quality improvement methods came under scrutiny.<sup>25</sup> Companies reported poor objective results despite intensive staff education programs and corporate commitment to quality improvement.<sup>26</sup> One response to this criticism was to emphasize performance goals and outcome measures, a technique known as "benchmarking," or evaluating performance against specific criteria, including the performance of competitors or industry leaders. "Benchmarking is an external focus on internal activities, functions, or operations in order to achieve continuous improvement."<sup>25</sup> Benchmarking in industry consists of four phases: planning (a process of deciding which areas should be studied and how to collect data); data collection; data evaluation; and finally, application of the results to the system under study.<sup>27</sup> In Canada, the Health Medical Records Institute (HMRI) provides data to hospitals about measures such as mortality and length of stay, re-admission rates, and other utilization data on a periodic basis, and is an important source of information about comparative performance. Unfortunately, little information is directly applicable to an anaesthetic department.

#### *Current directions*

In 1992, the American Quality Foundation and Ernst and Young, a management consulting company, published a large multinational cooperative study, the Best Practices Report.<sup>28</sup> This investigation attempted to develop a practical and factual basis for the management techniques used in quality improvement. Over 580 organizations were surveyed from four industries, including health care. Although quality improvement had evolved to a common set of recommended practices, this study found that different management practices should be employed by enterprises at differing levels of performance. For example, companies performing poorly were found to gain little from widespread participation of employees in planning and quality management, or from use of

\*Personal Communication. Dr. D. Berwick, University of Alberta, October, 1992.

benchmarking against world class organizations. However, they did benefit from team building and from training of employees in customer relationships. Similar types of recommendations were made for both the medium and highest performing enterprises. Future study of quality improvement methods may allow more appropriate application of these techniques to health care.

Thus the history of quality was based on two concepts, control and improvement. In Shewhart's era, quality control required the process to be stabilized (free from non-random variation) so that statistical methods could be applied. Similarly, in its effort to provide conformity to standards, QA contributed to stability of process and outcome. More recently, the development of practice guidelines is an attempt to ensure quality by elimination of unjustified variation in care provided by physicians.<sup>3,11</sup> The focus for this activity is at the level of national organizations.<sup>29</sup> In contrast, QI has shifted the responsibility for quality from QA specialists or other third parties to empowered workers or care givers. In doing so, QI has become a goal in its own right.<sup>30</sup>

A third concept, quality planning, has been recognized but not used frequently in Canadian health care, although it is important in other fields.<sup>31</sup> Quality planning is an activity which attempts to recognize and anticipate the requirements of external customers, e.g., patients. Based on an iterative process of five steps, quality planning starts with identification of customers and determination of their needs, followed by transformation of these requirements into organizational performance objectives. These in turn direct the design of future products or services. Once production or implementation of the enhanced product or service is initiated, the process is repeated.<sup>31,32</sup> The services provided by government-funded health care institutions are not usually viewed by their administrators as actively determined or malleable "products." However, encouraged by pressures from Health Ministries for regionalization and rationalization of services, hospitals are beginning to recognize the need to respond to specific customer or patient needs. The extent to which quality planning techniques will be applied to health care in Canada, and to what effect, remains to be seen.

## QA versus QI

### *Quality assurance – an overview*

Quality assurance was widely adopted by Canadian health care facilities in the 1980's, in part due to incorporation of requirements for QA into the CCHFA accreditation documents. Several published models describe the components of QA, both in hospitals and anaesthetic departments.<sup>33-35</sup> The underlying principles of Structure, Process, and Outcome originally proposed by Donabe-

dian form the basis for most of these models and deserve emphasis.<sup>20</sup> Structure represents all components of the facility, organization or department. These components include administration, where the work is carried out (environment, physical plant), by whom (personnel), and with what (equipment). Process refers to measures which describe the characteristics of the system in operation. These measures define what is done (tasks) and how it is done (methods). Outcome represents the final results of the organization. These results may be defined according to simple study of what has been accomplished (audit) and assessment of results in comparison with internal and external standards (evaluation). Taken at their most basic, this triad constitutes a method to determine whether a system is organized, working and producing to its optimum level.<sup>36</sup> Structural elements are usually the easiest to measure: the environment is or is not acceptable; equipment is or is not present and functioning; personnel do or do not have the proper credentials; and they are or are not present in adequate numbers.<sup>36</sup> Process and Outcome are somewhat more difficult to assess. Procedural assurance can be considered to be the basis of how the practice of medicine changes,<sup>33</sup> although a strong link with Outcome measures is required. For many individuals, Outcome measures have been synonymous with QA. Indeed, in the United Kingdom, QA programs are known as "Audit." This presumably follows from the commonly held assumption that if Structure and Process are deemed acceptable, then acceptable Outcome will follow in due course.<sup>37</sup> In fact, this relationship has never been proven and requires further investigation.<sup>38</sup> Furthermore, to focus on only one component of the triad is to risk inadequate understanding of the dynamics of interaction of the three components in any system. Although the relative importance of Process and Outcome measures has been debated,<sup>38</sup> a comprehensive QA programme must include Structure, Process and Outcome.

These definitions may be applied to an anaesthetic department. Examples of Structural components include the operating rooms, anaesthetic machines, and complement of adequately trained staff. Examples of Process measures should include the total number of patients who move through the system, and how many undergo each form of anaesthetic, i.e., general, regional (spinal, epidural, plexus block). Examples of Outcome measures include the five D's: death, disease, disability, discomfort, and dissatisfaction. A sixth D refers to dollars, the cost of treatment of complications, including legal action.<sup>39</sup>

However, care provided by anaesthetists usually does not provide cures and "facilitates treatments of patients rather than providing primary therapeutic benefit,"<sup>40</sup> thereby making quality potentially difficult to assess. This has prompted a modification, both in clinical care and

research, of the traditional definition of Outcome to include certain Process events, and indeed, studies which combine the two are considered "state of the art."<sup>39,41</sup> Thus in anaesthesia, the selection of Outcome variables emphasizes the points of view of the patient and anaesthetist. The other observers of quality (minimally the surgeon and healthcare system) are less well represented, perhaps with some cost. From the point of view of the patient, Outcome remains focused on complications such as mortality and morbidity. From the point of view of the anaesthetist, Outcome includes an assessment of unexpected alterations in planned care, for example unanticipated admission to ICU,<sup>35</sup> or events requiring corrective action by the anaesthetist,<sup>40,42,43</sup> for example unexpected hypotension or hypertension. This altered definition of Outcome is important to recognize. With respect to Process measures, assessment of this type of Outcome has been facilitated by use of automated record systems which allow capture of on-line data.<sup>44</sup> Since the effect of anaesthetics on major outcomes is small, it has been suggested that minor adverse outcomes which are particularly distressing to the patient should be a major focus for further improvement in the quality of anaesthetic care.<sup>40</sup>

Once a department initiates a QA program, data must be collected and reviewed. Most anaesthetic departments will not have the resources required to study all patients treated, although such programmes have been described in detail.<sup>40</sup> Decisions, about which data should be collected and how they should be reviewed, are not trivial.<sup>35</sup> In simplest terms, the most critical of the department's activities need to be sampled and measured. Over a period of time, some activities may be added and others dropped as knowledge is gained about performance. Sampling of cases can be accomplished by several methods. The most basic is to look only at important events, for example traditional mortality review of deaths in the operating and recovery rooms. Alternatives include looking at a given proportion of all cases or selecting those which meet certain preconceived criteria, e.g., respiratory rate less than six per minute in recovery room.

Most medical records departments are able to provide information about issues such as unanticipated admission after day care surgery, but recently recognized elements, such as patient satisfaction, may require development of new tools.<sup>40,45</sup> Patients have been recognized as reliable reporters of both the "what" and "how" of some types of medical care.<sup>45,46</sup> This has not been applied widely in anaesthesia.

How the measurement of practice is carried out is as important as the measurement itself. The image of the "Bad Apple" defined by Berwick<sup>21</sup> caught the attention of QA specialists and their critics alike. According to

Berwick, QA "by inspection" causes workers, including physicians, to defend, deny, or cover up their actions. This negative response to QA, particularly on the part of anaesthetists, was reinforced by some of the activities of Professional Standards Review Organizations (PSROs) in the United States. The PSROs were established in 1972 to ensure that certain health services, i.e., those financed by Medicare and Medicaid, were "medically necessary and provided in accordance with professional standards."<sup>47</sup> In 1984, PSROs were replaced by Peer Review Organizations or PROs. In the late 1980's, The Health Care Financing Agency in the United States (HCFA) sent guidelines to PROs indicating arbitrary limits for intraoperative vital signs, e.g., heart rate and blood pressure. Exceeding these limits would trigger external review.<sup>48</sup> This type of arbitrary screening had obvious implications for practitioners.

More recently, the practice of QA has incorporated some of the attributes of QI (see below) by deemphasizing the "Bad Apple," placing more emphasis on improving Outcome, and thereby reflecting the initial, equal emphasis of Structure, Process, and Outcome in QA. Measures of Structure, Process and Outcome have been more readily accepted when practitioners control screening variables, receive feedback from the monitoring system, link the feedback to educational activity, and perform truly peer-based review. This is usually best done at a departmental level,<sup>49</sup> but consideration must be given to provincial and federal regulations. Part of this approach was incorporated by Vitez into his model for measurement of clinical competence.<sup>42</sup> More traditional models have been incorporated into Canadian anaesthetic practice. For example, for the Medical Quality Improvement Office at the University of Alberta, groups of physicians develop criteria, review identified cases, and make recommendations about change in practice.\* More recently, QA has been identified as a valuable educational tool for practitioners, and peer review has been an important component of recent models.<sup>42,50</sup>

An example of application of the principles of QA to anaesthesia is that of the study by Pagenkopf and colleagues.<sup>45</sup> They conducted an audit of patient outcome after obstetric analgesia or anaesthesia as part of routine QA activity. Two types of data were collected: technical details and "Patient Described Outcome (PDO)." The former were determined by means of chart review and allowed comparison of results with internal and external standards. The PDO data were determined by patient interview and questionnaire. The interview was carried out and the questionnaire administered by a volunteer,

\*Personal Communication. Dr. B. Finucane, University of Alberta, October 1992.

providing a cost-effective means of data collection (which was organized to match the availability of patients). Although technical results were considered important, the PDO information provided details about Structure, Process and Outcome previously identified but not confirmed. For example, some patients reported delay in provisions of "top-up" doses of local anaesthetic, suggesting a Structural problem in the availability of anaesthetists. Perceived loss of control by patients represented a Procedural problem. Outcome data included reports by patients of considerable satisfaction (which was then relayed to the anaesthetists), illustrating that QA need not report only the negative. The authors concluded that their audit balanced objective and subjective evaluation and provided a means of closing the feedback loop of information necessary for effective QA.

#### *Quality improvement – an overview*

Quality improvement did not arise as an academic discipline with a clearly defined terminology and knowledge base. Several models of QI were developed independently by experts to solve diverse problems in varied environments, ranging from business and industry. Each model was based on the experience of the consultant. Consequently, a wide variety of models was developed with similar features but different names and terminology, for example, CQI, TQM, QM, etc. Some of these have been applied to health care.<sup>51,52</sup> In its most general form, quality improvement has two components: a group of values about human and organizational performance, and a set of problem solving techniques, each employed at a given step of the problem solving process (Table II). There are four major tenets of QI. First, problems which produce poor quality originate with operation of the system, and not with the people working within it. Second, all workers must be involved in teams seeking and maintaining improved performance.<sup>53</sup> In hospitals, everyone, from the chief executive officer to the hospital cleaner (including physicians), is expected to be equally committed to quality improvement. Third, quality is seen from the viewpoint of the customer, where the customer may be "external," e.g., the patient who is seen as a "customer" of anaesthetic services, or "internal," e.g., the surgeon who is seen as a "consumer" of anaesthetic services. Fourth, poor quality is costly and steps taken to improve quality will reduce costs. These four characteristics distinguish quality improvement from traditional QA.

The study of Process (of provision of care or production in support services) is central to the improvement of quality. A number of tools are now used to facilitate this.<sup>54</sup> These were taken from diverse sources ranging from economists (Pareto diagrams) to industrial engineers (control charts). The tools, which allow systematic study

TABLE II Quality improvement problem-solving techniques

| <i>Steps in solution of problem</i>                 | <i>Example of appropriate technique</i>  |
|---|--|
| 1 What is the problem to be addressed?              | Critical incident reviews; utilization data; performance data, control charts  |
| 2 Develop a clear, precise statement of the problem | Task of multidisciplinary quality management committee   |
| 3 What are all the possible causes of the problem?  | Delphi survey, cause and effect diagram  |
| 4 What are the root causes of the problem?          | Pareto diagram   |
| 5 Develop and implement a solution                  | Task of multidisciplinary quality management committee   |
| 6 Monitor the effectiveness of the solution         | Traditional QA; utilization data; quality control charts, comparison to other departments or institutions (benchmarking) |

of a wide variety of problems, are of three kinds: those to collect and organize data; those to present data; and those to provide insight about the basic characteristics of the process under study. None of these was developed specifically for quality improvement, but grouping of the tools is unique. Data collection methods include: sampling techniques for repetitive processes to provide data amenable to statistical analysis; questionnaires for collection of opinion, for example brain storming; and nominal group techniques.<sup>55</sup> Data presentation methods include histograms and process control diagrams. Methods which provide insight into process characteristics include flow charts, cause and effect diagrams, and force-field diagrams. All of these tools can be augmented by use of pre-existing information, for example, data from utilization studies.

Use of quality improvement methods in health care has been widely discussed in the United States and Canada, in part provoked by The National Demonstration Project on Quality Improvement in Health Care. This study, funded in 1987 by the John Hartford Foundation and the Harvard Community Health Plan,<sup>30</sup> was an eight-month inquiry into the effectiveness of quality improvement tools in a variety of health care settings. The results created widespread interest in these methods in health care institutions in the United States. There are no reports of the application of QI methods to anaesthetic problems. However, one segment of the National Demonstration Project (NDP) used these techniques to resolve a problem of frequent postponement or cancellation of surgery due to incomplete patient records. Several hospitals in Canada have adopted institution-wide QI programs, while others have been less ambitious. The ultimate benefit of these programmes remains to be seen.

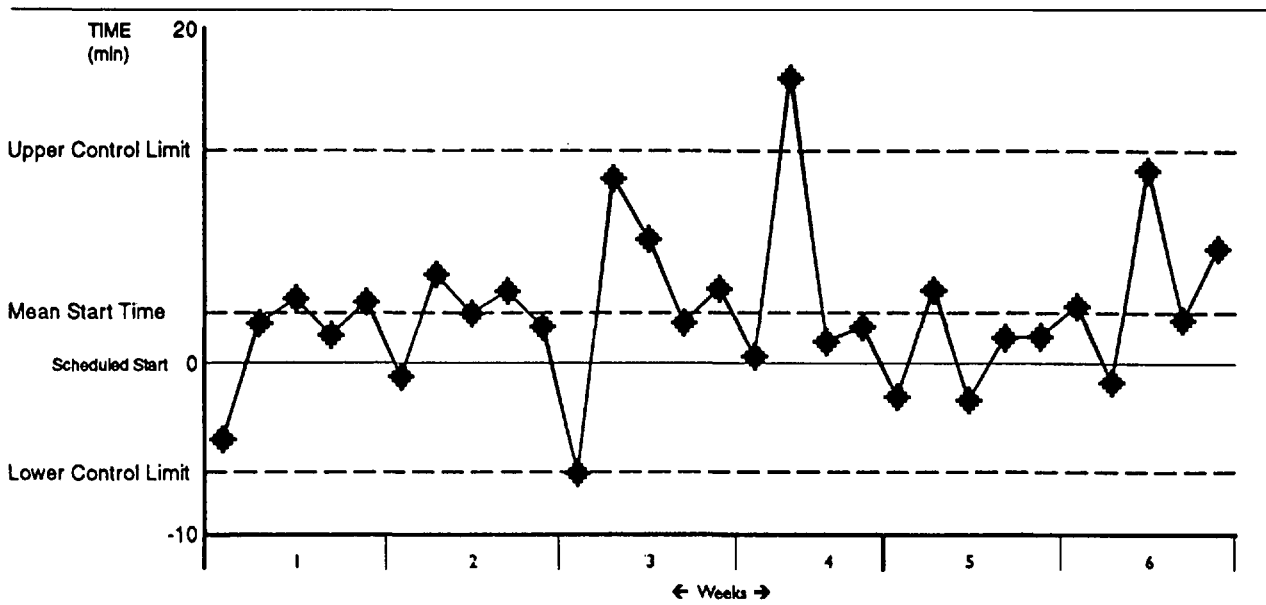


FIGURE 1 Control chart: mean time to start of first case for each day studied.

Use of some of the principles and tools of QI can be illustrated by a specific example. Perceived delay in the time of arrival of the patient in the operating room is a frequent cause of dissatisfaction. At Foothills Hospital, an analysis of the arrival time of the first patients of the day into the operating rooms (start time) was performed retrospectively on one year's data. An existing computer database provided numerical assessment of start times but not identifications of causes of delay. A control chart was constructed for 2634 starts (Figure 1). The average arrival time of patients in the operating room was found to be eight minutes behind schedule, where scheduled start time was 0750 hr and average start time was 0758 hr. The calculated cost of this delay was approximately \$200,000. To eliminate the problem, a quality improvement group was established by the Operating Room Committee, under the direction of the Director of Anaesthesia.

No information was available about the transport to and arrival of patients in the operating room. Thus, a Delphi survey was performed to obtain qualitative (opinion-based) data from staff nurses, surgeons and anaesthetists about causes for the delay. Responses were analyzed and presented in the form of a Pareto diagram (Figure 2) for easy identification of the major perceptions. The four factors with highest ranking were incomplete consent forms, portering, delay in obtaining ECGs, and access to elevators, in order of decreasing importance.

Numerical information was then collected prospectively on patients coming to the operating room. Times were recorded for the departure of the porter for the nursing

unit and arrival on the nursing unit to pick up the patient. Times were also recorded for each patient's departure from the nursing unit, arrival at the patient holding area, and arrival in each operating room. These data showed that absence of the patient's history, late arrival of the patient in the holding area, and lack of availability of the ECG were the major causes of lost time, in order of decreasing importance. The subjective data and that based on objective measures were substantially different. Incomplete consent, while widely appreciated, was actually a minor objective cause of delay. Absence of patient histories, the major objective cause for delay, was not identified by the staff. Since the next step was to remedy the major cause of delay, a false start would have occurred if subjective data had been relied on exclusively. This underlines the importance of obtaining quantitative data in this type of QI project.

Immediately following initiation of the prospective study, the average delay in start time decreased from eight to three minutes, indicating a pronounced Hawthorne effect. (The Hawthorne effect predicts that a minor environmental change, in this case the act of observation, will result in a transient change in performance.) The five-minute difference disappeared after two weeks. In addition, in an attempt to eliminate late starts, an independent change was made by a nursing administrator with the result that all operating room nurses reported for work 15 minutes earlier each day. Analysis of control charts of start times showed no improvement from this change of nursing service. This observation further supports the concept that only objective analysis of problems



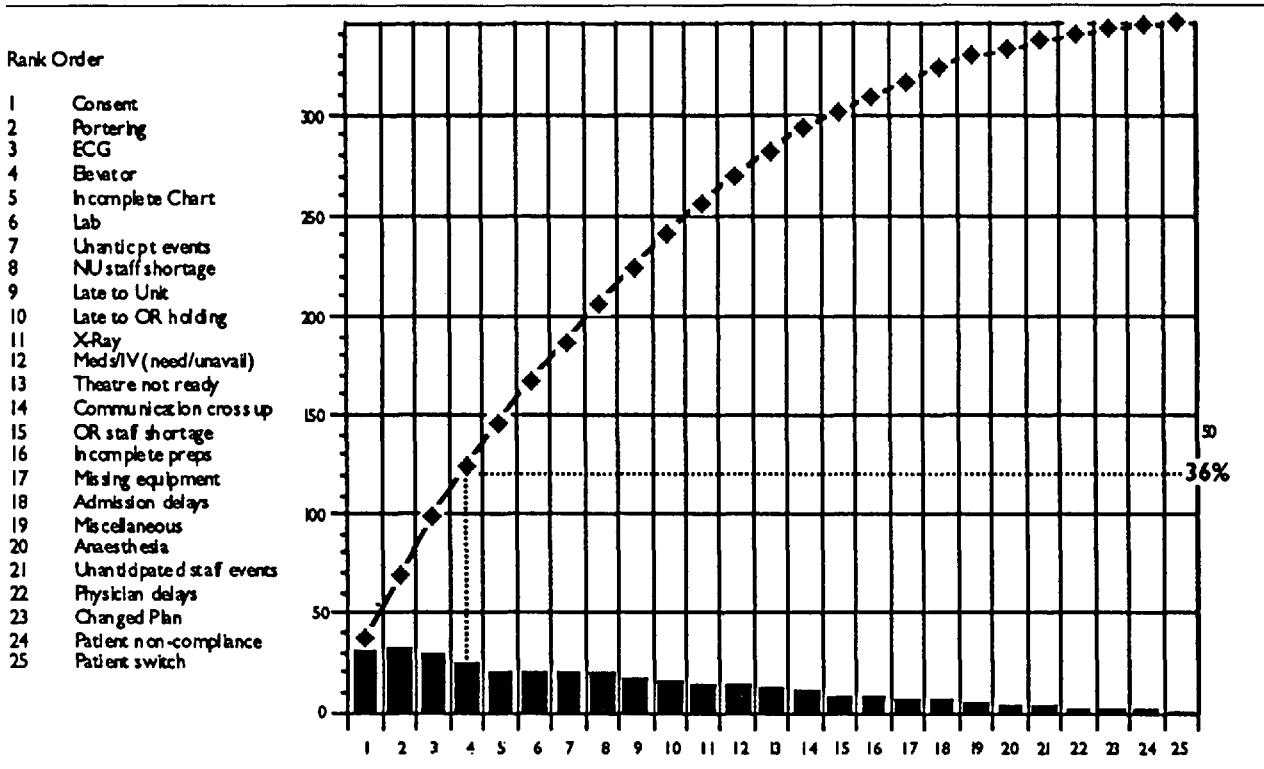


FIGURE 2 Pareto diagram results for Delphi survey.

will result in effective solutions. As a result of the study, steps are underway to address the causes of delay. Whether or not these will be successful depends on many factors. Some of the major reasons that the remedies may or may not be successful are shown in the force field diagram (Figure 3).

**An integrated system for quality**

The start of QI several years after the development of QA has added complexity to hospital administration and resulted in confusion about the role of each. In addition, it is recognized that the ability to solve problems requires close additional links with risk and utilization management. Responsibility for these activities often rests in different administrative portfolios, adding further complexity. Potential benefits of integration were first noticed for QA and QI and included elimination of duplication of activity and cost effectiveness.<sup>56</sup> Some institutions have attempted to integrate the areas of risk management, QI, QA, and utilization management into a single system. For example, an incident resulting in poor patient outcome may cross all boundaries. First, the incident may be investigated as a critical event using principles of risk management.<sup>57</sup> Second, results of the investigation may initiate a QI project to eliminate causes of the incident. Third, the traditional QA system may be used to construct

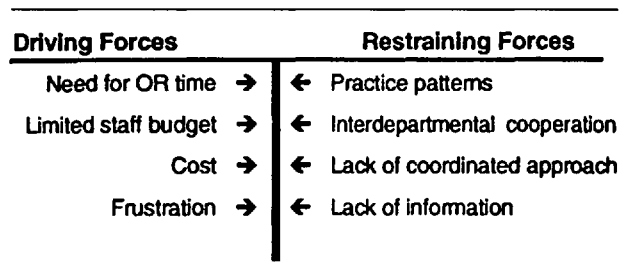


FIGURE 3 Force field diagram showing factors affecting likelihood of improvement of theatre start time.

event markers and tracking methods to judge the effectiveness of the results of the QI project. Fourth, utilization studies may be required to allocate sufficient resources for the problem to be solved.

Several hospitals in Canada have developed integrated Quality Management programs which formally link risk management, QA, QI, and utilization management. From this perspective, Quality Management may be seen to be composed of four components producing different rates of change in the institution. In the area of risk management, review of a critical incident should occur as soon as possible after the event. Quality improvement, because of the repetitive steps of planning, doing, checking, and acting (PDCA),<sup>55</sup> invokes a slower rate of re-

sponse. Quality assurance requires ongoing data collection and comparison with external and internal standards and may produce change slowly. Utilization management deals with reallocation of resources based on QA, QI, strategic or financial planning, and therefore may result in the slowest rate in change in the institution.

Integration of these four elements may be useful at the level of departments. Most anaesthetic departments have existing systems of data collection and reporting, which are the basis of QA. These may be the focus for an integrated model. Data obtained can be used to identify important problems amenable to QI techniques – if staff have sufficient training, time, and motivation. Most departments use some type of utilization management if only because of budgetary restrictions. Link of utilization management to a quality management structure has the potential advantage of aligning resources to the major functions and deficiencies of the department, and may also serve as a staff education tool. Critical incident review can be added as the risk management component to complete the model.

In its original conception, QA placed equal emphasis on Structure, Process, and Outcome. In practice, QA was often perceived as a requirement for accreditation, with most emphasis on Structure and Process. A more balanced view may emerge from the integrated model described above, which re-emphasizes Outcome through risk and utilization management. In addition, the emerging focus on consumer satisfaction placed additional emphasis on Outcome. However, the primary Outcome measure, the effect of the hospital on the health status of its community, is not yet available, but health status may be enhanced by optimal use of scarce resources, a goal inherent in QI.

#### External constraints

Finally, some activities in quality assurance and quality improvement are not self-actuated. For example, the periodic review of Canadian health care facilities by the CCHFA requires attention to the expectations of accreditors. Which parts of the review are relevant to anaesthetists? The CCHFA requires a clinical profile of the anaesthetic department, including information about the total number of anaesthetics administered, the type of anaesthetics employed (local, regional, or general), and the locations where anaesthetics are administered. Evidence of quality assurance activity is also required. Information is sought about the number of complications (categorized by ICD9-CM code), critical incident investigations, audits and utilization review. It might appear that such an approach would encourage independent and potentially counterproductive activities by various hospital departments. In fact, the accreditation process seeks

to balance central control and coordination with independent activity. This is exemplified in the accreditation requirements for risk management.<sup>17</sup>

Anaesthetists may also be involved with aspects of the review which deal with the facility as a whole. The administration of the hospital is required to implement facility-wide quality assurance programs and overall policies and procedures for quality assurance, including the generation of reports by each department. Similar requirements exist for utilization review (which includes measurement of occupancy, length of stay, admissions and re-admissions, consultations performed, etc.) and risk management. The hospital is required to ensure proper linkage between QA activity and risk management, to facilitate sharing of information between departments and to prevent unnecessary duplication of activity.

The accreditation document also includes an extensive list of requirements for the activities of the operating suite and recovery room. Administrative nurses will be most intensively involved with the documentation of conformance to these standards. The standards require these areas to have: (1) a statement of purpose, goals and objectives; (2) appropriate organization and qualified leadership; (3) written policies and procedures; (4) appropriate human and physical resources; and (5) provision of orientation, staff development, and continuing education. Anaesthetists may be called on to participate in the preparation or evaluation of these components. However, accreditation standards are not static. Future standards of accreditation, under consideration for implementation in 1994, may contain QM elements, including a customer and QI focus.\*

#### Conclusion

Numerous models of quality are pursued in Canadian hospitals. There is a plethora of terminology, commonly without precise definition. In addition, rigorous assessment of the efficacy of these models is in its infancy.<sup>28</sup> The result is a confusing picture, exacerbated by the rapid change in this field. Anaesthetists need to be aware of the basic models, terminology, and accreditation requirements. In addition, newer models of hospital-wide QM, which link activities such as QA, risk management, and utilization management into an integrated system, are of potential benefit.

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